against such regulations. They argued these policies would ultimately reduce the performance and increase the costs of their products. In the short term, they did. However, 25 years later there is no advocation to return to the days of the past and the public has benefited immeasurably.

SEA suggests the Commission adopt the transition plan proposed by SEA in its comments in this proceeding[34]. This approach will:

- offer long and short term efficiency gains,
- define a clear path to users and manufacturers alike,
- require only one wholesale changeout over a reasonable time period, and
- provide licensee incentives (spectrum retention) to implement new technology sooner rather than later.

D. The Adopted Emission Mask Is The Key To The Proceeding

SEA's support for the Commission's proposed emission mask is conveyed in its comments.[35] The development of a suitable emission mask is the key element to the success of this proceeding, though many commenters offered no input.

TIA's comments offer an alternative emission mask, devised for 12.5 kHz technology radio types (specifically analog FM and APCO 25

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[34] Comments of SEA at 17-19.

[35] Id. at 13.

transmitters). While we understand why it is in TIA's interest to support this mask, it is a good example of choosing a rule to fit a favored technology. The adoption of such a mask would not reflect good public policy, considering the pace of technology and the future needs of private radio users. The TIA mask would essentially freeze technology at today's level.

There is a dramatic difference between TIA's 12.5 kHz mask and its mask for 6.25 kHz channels. (This issue is discussed in detail in SEA's attached Appendix A.) The contrast shows how the adoption of the 12.5 kHz mask offers little promise for progressing to the implied 6.25 kHz step. It is clear that a 6.25 kHz channel cannot operate adjacent to a 12.5 kHz channel using TIA's scheme. TIA's 12.5 kHz channel emission mask would not offer enough inherent adjacent channel protection to a narrowband channel. This would surely discourage licensees from choosing or converting to narrowband technology, and probably give ample reason for users to abandon a future "voluntary" migration to 6.25 kHz (or equivalent) channels[36].

SEA notes that TIA ignores the concept of channel stacking by

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[36] It is easy to see another reason that users will resist a second step in any transition plan: expense. 12.5 kHz equipment will not be forward compatible with 6.25 kHz or equivalent systems. Users and user groups will justifiably oppose further change, because they will freshly recall the effort and expense involve in the first stage. Therefore, any staged implementation of increasingly strict efficiency standards and channel equivalency is doomed to failure as soon as the first stage of equipment is in place.

asserting, "(i)n effect, the FCC proposed mask forces manufacturers to one limited unproven technology."[37] In contrast, AAR supports the Commission's proposed emission mask[38], correctly pointing out that "...the proposed emission masks would enable users to combine channels for higher bandwidth applications."

UTC's comment that the proposed emission mask should be made more strict[39] surely must have been made in error. There is no FCC emission mask more strict than that proposed here (and adopted for the 220-222 MHz band). The maximum attenuation of 65 dB referred to by UTC applies to a displacement frequency 1.75 kHz from the edge of the channel emission under investigation. At higher displacement frequencies, the emissions must be attenuated at least 55 + 10log (P) dB, which is a minimum of 12 dB more strict than the typical requirement in ¶90.209[40]. 12 dB is a minimum because the proposed rules stipulate the method of measurement of spurious emissions. Specifically, the spurious products would be measured in a 10 kHz resolution bandwidth. This method typically yields higher spurious readings than, say, the use of a 300 Hz resolution bandwidth. Because of the stringent requirements of this mask, SEA is certain

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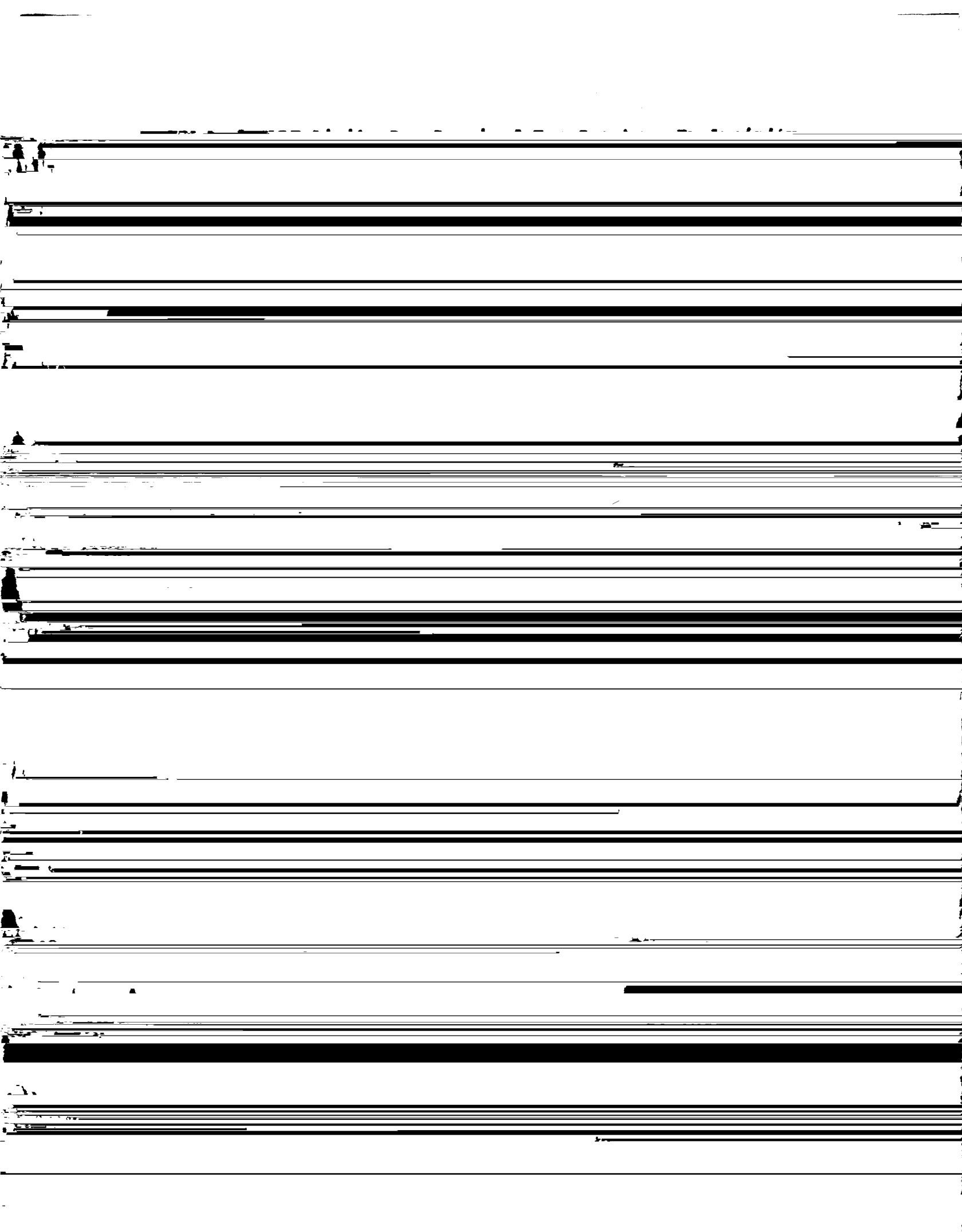
[37] Comments of TIA at 21.

[38] Comments of AAR at 38.

[39] Comments of UTC at 47.

[40] ¶90.209 typically specifies a 43 + 10 log (P) attenuation for spurious emissions. The two exceptions are those for the frequency bands 896-901/935-940 MHz (50 + 10 log (P)) and 220-222 MHz (55 + 10 log (P)).

that over the duration of the refarming transition process, spectrum pollution and interference problems will be reduced in the



pollution problems from that which exists today. It is not clear, however, that the "engineer-in" option would, in practice, permit simple coordination of co-channel stations.

Several commenters in this proceeding have pointed out that the existing databases available for coordination purposes are not common. It seems that additional confusion and inaccuracies in the databases could be avoided by keeping the "engineering-in" of systems to a scant minimum. However, there is reason to believe that, if it were adopted simply as an option, the "engineer-in" option would be the rule rather than the exception for applications for coordination.

NABER has suggested that an incentive should be developed to compel applicants "...to request only that size service area which is necessary."[42] NABER proposes channel exclusivity as that incentive

area for an applicant[43]. While the principle appears logical for maximizing the spectrum efficiency of the bands, the burden imposed

G. Offset Channels Users Must Be Afforded Spectrum For Their Applications

Notwithstanding the importance of the offset channels to the myriad of users, in SEA's view, any plan to permit them to continue indefinitely, let alone grant them primary status, will be as much an impediment to the implementation of new spectrum efficient technology as would the innovative shared use channels initiative.

It is clear that the genesis of the offset channels was rooted in the fact that such an application could coexist with land mobile operations (in a land mobile frequency band) because the systems were low power, restricted antenna height, and fixed. SEA opposes the proposals[45] to make offset channels primary, because to exist in this form they stand in the way of channel stacking and, as a result, the advancement of future technologies and efficiencies.

The most rudimentary example of this problem is the existing primary (and "preferred") 450 MHz licensee that is able to obtain exclusive use. This licensee should be able to stack five 5 kHz channels and construct a five-slot TDMA[46] system centered on the original channel if it is desired and justifiable. Primary status for the offset channels would jeopardize the ability to do this.

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[45] See, e.g., Comments of Alarm Industry Communications Committee (AICC) at 8.

[46] SEA believes that channel stacks consisting of fewer than five 5 kHz channels will be less feasible for TDMA because of the expense of these systems.

SEA suggests the selection of other more suitable bands for fixed operations. Displaced applications for fixed data, medical telemetry, signaling and control channels should be provided new spectrum and given incentives to use new technology. (For instance, spread spectrum technology, not widely believed to be suitable for mobile operations in an FDMA environment, is finding success in the 900 MHz band.) We do not believe the continuance of offset operation is consistent with the Commission's goals in this proceeding.

H. Consolidation of the Radio Services Should Be Performed With Efficiency In Mind

SEA's positions on issues regarding consolidation of the radio services have not changed as a result of reviewing the filed comments. In review, we recommend that the Commission:

- avoid any reallocation of spectrum in the refarmed bands,
- discard the innovative shared use concept, and
- consider that any consolidation should be made with the objective of developing contiguous blocks of spectrum for operationally or traditionally similar user groups.

I. Coordinators Should Be Directed To Develop Channel Pairings

SEA supports the Commission's proposal to permit centralized trunking of exclusive use channels below 512 MHz. Since the success of trunked system implementation in the refarmed bands depends on the frequency coordinators, the FCC should direct the authorized coordination groups to:

1) develop suitable regional or nationwide channel pairings for the 150 MHz band, and

progress of Project 25 to Refarming are invalid.

We might add that with the development of any revised APCO standard (with modified data rate and modulation scheme[49], etc.) that would be applied to channels in the refarmed bands, any concern regarding interoperability problems would be moot since 800 MHz radios do not communicate with 150 MHz and 450 MHz radios.

K. Review Of And Comment On Basic Objections To The Notice

Of the commenters, APCO perhaps most succinctly expresses the typical objections to the Commission's Notice. SEA reviews those objections[50] here and responds to each.

1. "Loss of contiguous public safety spectrum to other services in the 150-160 MHz band."

> This almost certainly alludes to the innovative shared use initiative. With the SEA proposals this would not occur.

2. "Interleaving of non-public safety services with those of public safety...etc." (Same objection as #1).

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[49] In reality, the modulation scheme would be changed from QPSK

With the SEA proposals this would not occur.

3. "The unworkable 5 kHz channel width proposal in the 150/160 MHz band."

Since no attempt is made to qualify the use of the word "unworkable", it is difficult to satisfy the objection. Certainly the APCO 25 technology, as presently defined, is not a workable approach in a 5 kHz channel. SEA encourages APCO and TIA to seriously consider an alternative modulation scheme. If the APCO 25 radio approach were a linear modulation architecture employing 16QAM modem, it should be found to be very workable.

4. "An offset channel plan that would essentially make all existing equipment obsolete, due to incompatible synthesizers."

This problem cited is merely one of many associated with the concept of attempting to maintain the 450 MHz offset channels as they are presently configured. SEA does not support the continued application of offset channels in the refarmed bands.

5. "Power limitations based on HAAT and ERP that will unnecessarily force state and local governments to build new transmitter sites...".

SEA supports a variation of LMCC's "safe harbor" approach. Even if state and local government entities "engineered-in" their systems they would still be eligible for exclusive use under the "imminent danger" clause[51].

6. "Unrealistic reduction of (FM) modulation (level) to (+/-)3 kHz (deviation)."

With the SEA proposals this would not occur, since there is no intermediate step in the transition to narrowband or equivalent technology.

7. "Potential loss of many or most of the mobile relay station assignments...lack of standard pairing... intermodulation from the high number of new channels..."

Indeed, we agree that repeater operation should be permitted and standard pairings should be developed. Such pairings, we contend, are best developed by the respective service coordinators. We do not agree, however, that APCO's interference concerns are valid (see below).

8. "Lack of a migration plan which would provide near term relief and maintain interoperability,...capable of developing into long term spectrum efficiency."

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[51] As expressed in proposed ¶88.187(d).

We believe our plan provides potential near term and long term relief to most land mobile user groups. Maintaining interoperability is largely a function of equipment offered the market. Since our plan includes only a single transition into new technology, manufacturers and users alike will have a clear picture of interoperability requirements.

We recognize that our plan is lacking adequate incentives for public safety users to convert to new technology before it is required by regulations. This would be the only way for the Commission to offer the "near term relief" that APCO states is missing from the proposal. Perhaps such incentives are unnecessary since many public safety users may wish to maximize the useful life of their radio equipment before any mandatory change out.

9. "...establishment of multiple frequency coordinators for Public Safety channels."

This concern has to do with the consolidation issue, on which SEA takes no position. SEA notes, however, that the establishment of multiple frequency coordinators may indeed place pressure on public safety entities to convert to new technology sooner rather than later in order to retain spectrum. This is because unretained spectrum would be in

eligibility group. For most other user groups this would seem like a good incentive to convert early. But for public safety users, who depend on public moneys and sometimes bond issues to finance large projects, the fear of "spectrum loss" could create significant anxiety.

L. Commenters' Interference Concerns Are Overstated

TIA and APCO draw attention to the potential for greater interference in the refarmed bands as a result of the selection of a narrowband channel spacing. Specifically, TIA states its concern that "...separating 12 million transmitters by 5 kHz or 6 kHz may result in serious intermodulation interference."[52] APCO claims "...as channels are split and the number of frequencies become greater these intermodulation and desensitization problems will increase...exponentially!"[53]

This is not correct. In fact the number of potential discrete intermodulation products will increase. But this does not mean the problems will increase, as explained below:

1) Receiver desensitization is a function of the total undesired energy presented to the input of a receiver. Present rules (47 CFR ¶90.205(b)) permit up to 350 watts output power for a given transmitter in the 150-174 MHz and 450-470 MHz

[52] Comments of TIA at 12.

[53] Comments of APCO at 28.

bands. A more typical FM base station power output is 100 watts (average power = peak power). Installed on a 6 dB gain antenna with 3 dB of system losses, the ERP of this typical system would be 200 watts. At highband, this 200 watts ERP would be developed on 15 kHz spaced channels. So in a simple model[54], the purpose of which is to quantify the causes of desense and compare today's frequency bands to refarmed ones, the average power spectral density of this environment would be 200/15 = 13.33 WERP/kHz. To maintain the same average power spectral density (psd), the following maximum ERP limits would have to be maintained by the respective technologies.

modulation type	channel spacing	ave power (psd x spacing)	peak ERP *
FSK	5 kHz	66.7W	66.7W
QPSK	12.5 kHz	166.7W	166.7W
16QAM	5 kHz	66.7W	120.0W
ACSB	5 kHz	66.7W	167.5W

* FSK, QPSK and analog FM have 0 dB peak to average ratio
16 QAM has 2.55 dB peak to average ratio
ACSB has (conservatively) 4 dB peak to average ratio

Note that, coincidentally, the desense risk of filling the band with 5 kHz ACSB is approximately equal to that of filling the band with equivalent power 12.5 kHz spaced constant envelope QPSK.

[54] Ignoring statistical chances of multiple transmitters keying simultaneously, geographic separations, etc.

We contend that new ERP/HAAT restrictions will reduce the average power spectral density of these bands. Furthermore the FCC's proposed emission mask will precipitate new equipment with significantly better out-of-band emissions performance. These new rules will mitigate beyond concern the potential for a worse desensitization interference environment than currently exists. Indeed, the ultimate adjacent channel, desense and wideband noise environments will undoubtably be far superior to that which exists today.

2) Intermodulation distortion is the result of the energy of multiple carriers in the presence of some non-linear electronic device, which might be an over-driven receiver amplifier transistor or a rusty guy wire bolt connection to an anchor. We submit that the argument that the creation of more channels is a reason for reconsideration of the proposal is illogical. Consider the case of a new frequency band, 30 MHz wide using 15 kHz channel spacing, which would create 2000 channels. This band would have the same number of possible intermodulation mechanisms and problems as the 150-160 MHz band with 5 kHz channel spacing. We seriously doubt that anyone would object to a new 30 MHz frequency allocation because such an allocation would have too many intermodulation mechanisms.

The concern for worsening intermodulation distortion at

highband, we agree, is a rational one, but only because such problems already exist. In part this is because of the use of older generations of equipment and the fact that some sites are not adequately maintained. UTC suggests that the Commission add rules which regulate the management of antenna sites[55], an idea with merit which might be addressed in a future Commission action.

A further concern raised is that regarding amplitude modulation. APCO states, "(a)ny type of amplitude modulation can also increase the potential for interference through rectification of signals...".

SEA notes that any two rf carriers may be detected as an AM signal. This includes two FM or CW signals. This is because the two carriers "beat" against one another and may be AM detected as the difference frequency. Two unmodulated carriers spaced 12.5 kHz, therefore, may be detected due to rectification and manifest themselves in the form of the difference frequency, 12.5 kHz. Two modulated carriers separated by 12.5 kHz create more noise since the difference frequency detected would be a continuously variable signal extending across the audio frequencies. SEA contends that this is not merely a phenomenon of AM, but of rf in general.

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[55] Comments of UTC at 57.

SEA is convinced that the Commission's proposals do not chart a course to unmanageable interference. SEA believes that if the rules adopted do not stray far from those proposed, there will be fewer interference problems in the refarmed bands.

M. Errata

SEA concurs with UTC that the provisions for 220-222 MHz slow growth expressed in ¶90.727 should be reflected in the new ¶88.135.

In the proposed paragraph on Emission Masks, ¶88.421(c), the text should be corrected to include the definition of the variable "P", i.e. "...any emission must be (attenuated) below the power (P) of the highest emission contained within the authorized channel bandwidth as follows:...".

III. CONCLUSION

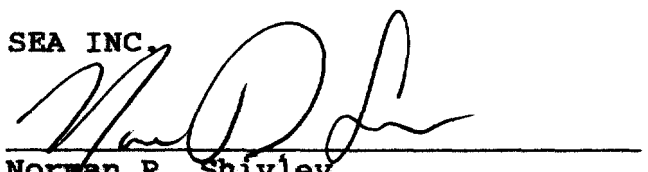
In the past, the Commission could adopt service rules that conformed to a single technology and emission type. It can no longer afford to do so. It is in the interest of spectrum efficiency and technology advancement that the Commission must carry out this initiative.

The technical parameters, incentives and new concepts associated with this proceeding must be developed in harmony with one another. For instance, SEA notes how the emission mask is conducive to both channel stacking and the cleaning up of the bands. SEA has developed a relational chart which expresses the interaction of these initiatives, which is shown in Appendix B.

For the foregoing reasons, SEA urges the Commission to carry out its basic proposals and adopt replacement rules for the Private Land Mobile Radio Services below 512 MHz that will best serve the public interest. SEA's replies herein and previously filed comments reflect our views of what constitutes a reasonable and realizable plan. When coupled with the technical parameters we propose, the Commission's plan will achieve much higher spectrum efficiencies and the impetus for further technological growth in the Land Mobile services.

Respectfully submitted,

SEA INC.

By: 

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Appendix A

ANALYSIS OF TIA-PROPOSED EMISSION MASK

TIA has recommended a specific emission mask for 12.5 kHz spaced channels in the refarmed bands. Included in the TIA recommendation is a mask for 6.25 kHz channels[1]. The 6.25 kHz mask is offered "...to provide for the possible future migration to 6.25 kHz channels".

TIA does not discuss how 12.5 kHz channels might be placed in the refarmed bands with respect to today's channels. Motorola, however, which supports the TIA emission mask recommendations[2], does discuss how 12.5 kHz channels would be placed[3].

Motorola's plan for the 421-470 MHz band[4] seeks to retain existing 25 kHz-space channel centers and to convert to 12.5 kHz technology. Motorola's plan also calls for conversion of offset operation to primary status. The result of these conversions is illustrated below in Figure A-1, where the emission mask limits are shown in relationship to such a channel plan.

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[1] Comment of TIA at 21 and Appendix B.

[2] "Motorola fully supports the comments of TIA...", comments of Motorola at 33.

[3] Comments of Motorola at 26.

[4] Motorola's 150 MHz plan is not discussed here. Motorola offered a plan for transition to 12.5 kHz channel spacing for the 150 MHz band as well. This plan suffers from too many transitions which, as we point out in the body of this filing, would be prohibitively expensive and disruptive to the band to actually implement.

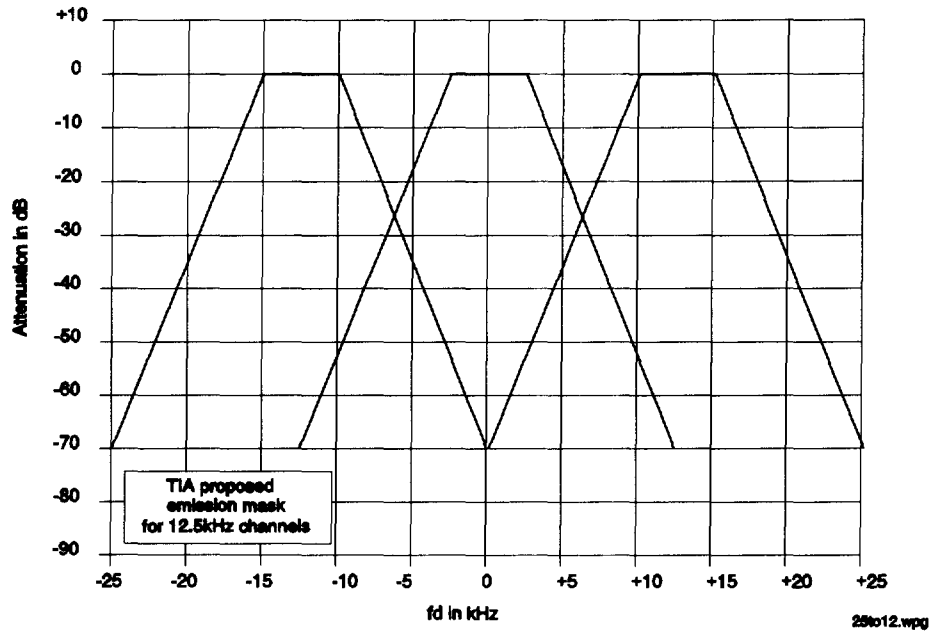


Figure A-1

The TIA-proposed mask appears to offer sufficient inherent adjacent channel protection to adjacent 12.5 kHz-spaced neighbors in its out-of-band emission attenuation schedule. SEA notes that the highest permissible emission at the center of an adjacent 12.5 kHz channel would be approximately 60 dB below the reference level of the victim's passband[5].

Motorola proposes that the 6.25 kHz channel plan should be established with the channel center frequencies offset 3.125 kHz from the 12.5 kHz channel centers. The relationship of the proposed emission masks to this transition step is illustrated in Figure A-2.

[5] SEA cautions that this does not represent 60 dB adjacent channel protection. Rather the 60 dB number is used here as a relative figure of merit. The actual "real world" FM transmitter adjacent channel splatter is, in fact, quite different from that revealed in a type acceptance occupied bandwidth test.

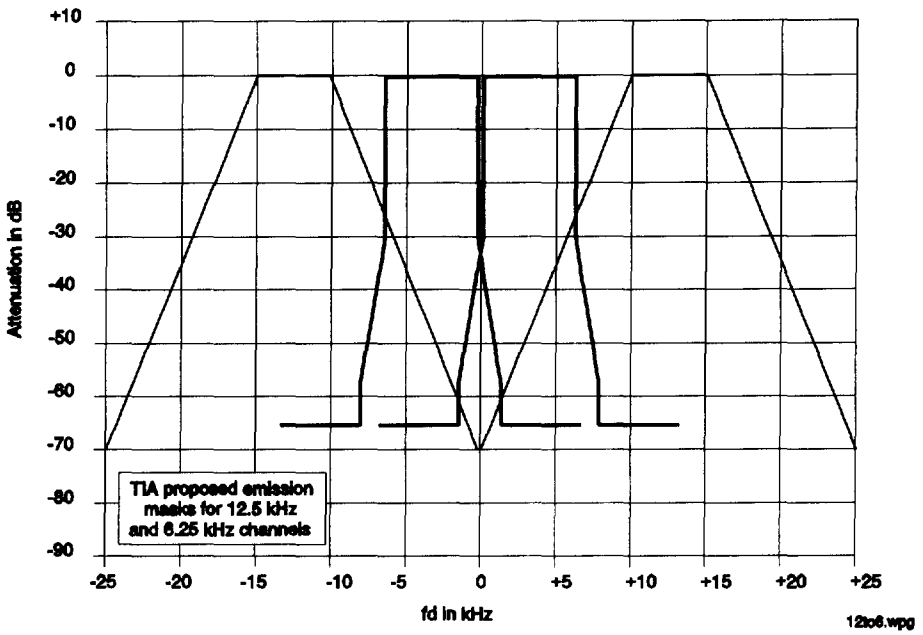


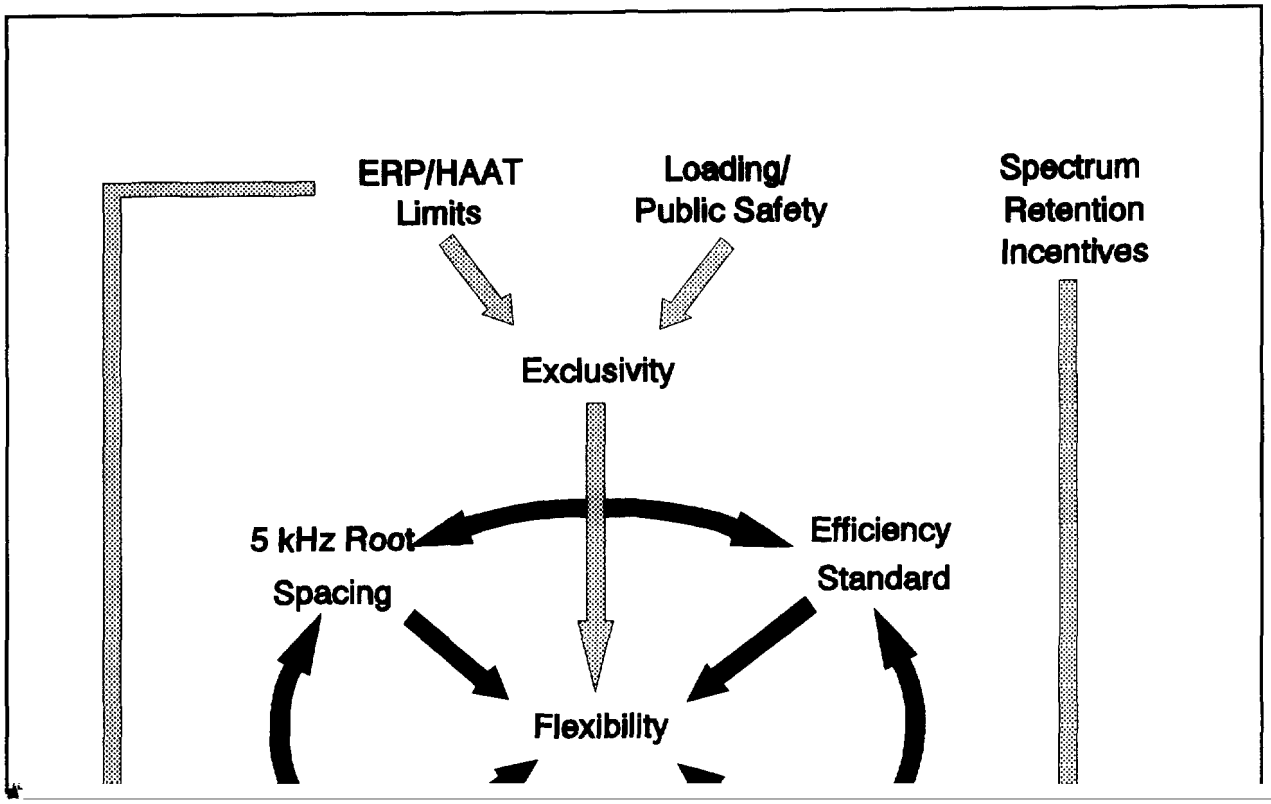
Figure A-2

Motorola states that "...this would allow the users the option of choosing very narrowband technology without impacting users on the adjacent channels"[6]. SEA believes the 6.25 kHz mask would indeed protect adjacent users of 12.5 kHz channels. However, the 12.5 kHz channel mask is woefully inadequate to protect the users of 6.25 kHz channels from interference created by the adjacent 12.5 kHz channels. As opposed to the 60 dB inherent protection provided to 12.5 kHz neighbors, the 12.5 kHz emission mask affords only about 40 dB noise attenuation in an adjacent 6.25 kHz channel. We believe that if such an approach were adopted, it would indeed preclude the use of 6.25 kHz equipment that Motorola claims its recommendations would not preclude. This is because the threat of interference would be a disincentive for users to convert to the narrowband channelization. We feel this "voluntary" plan would have few volunteers.

SEA submits that the emission mask proposed by the Commission in the Notice, along with the ability to stack channels, will avoid this problem and offer the greatest degree of technological flexibility.

[6] Id. at 27.

Appendix B


ERP/HAAT
Limits
Loading/
Public Safety
Spectrum
Retention
Incentives
Exclusivity
5 kHz Root
Spacing
Efficiency
Standard
Flexibility